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An Address
ON
THE HISTORY OF THE INVENTION
AND DISCOVERY OF SPECTACLES.

BEING THE INAUGURAL ADDRESS DELIVERED BEFORE THE
MEMBERS OF THE BRADFORD DIVISION OF THE
BRITISH MEDICAL ASSOCIATION.

BY
GEORGE H. OLIVER, D.O.Oxon., L.R.C.P.Lond.,
M.R.C.S.

ASSISTANT SURGEON, ROYAL EYE AND EAR HOSPITAL, BRADFORD;
PRESIDENT OF THE DIVISION.

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THE HISTORY OF THE INVENTION AND DISCOVERY OF SPECTACLES.

SCIENCE has been very lavish in the benefits she has conferred on mankind. A host of subjects occurs to one's mind in this relation: the steam engine, telescope, telegraph (in its various forms), telephone, microscope, etc., and, giving full consideration to each useful invention and discovery depending on the revelation of some hitherto hidden secret of Nature, none is of more importance than the observation that a biconvex lens apparently increases the size of the object viewed through it. On this observation rests the invention of a large number of optical instruments, including the spectacles or eyeglasses with which to-day we are so familiar.

Words fail me to give an adequate description, or to present to you any idea of the enormous benefit that has accrued to humanity from the use of spectacles. What should we do without them? When we consider that the emmetrope at 50 is no longer able to read ordinary print, nor to write at the usual distance, we are struck with the fact that all those above that age and in both sexes would be barred from the most useful and pleasure-giving func-

tions and exercises of which their organisms are capable. What an enormous loss it would be to the world if every one at this age was put out of gear, so to speak, regarding reading and writing! This means something of still greater importance—namely, that without glasses a very large proportion of these people would be prevented from earning a living.

Our imagination might carry us into every grade of society and phase of life, and suggest to us not so much, perhaps, that the loss of this great boon would be a calamity as that we enjoy in its use one of the greatest, if not the very greatest, blessings that has ever been conferred on us by a mixture of empiricism and science.

I think you will agree with me—at least, I am hoping so—that anything that can affect not just you and me, not only this town and neighbouring towns, and not even whole countries, but the whole world—the entire human family—as spectacles do, a little time devoted to the study of their discovery will not be altogether without interest.

This inquiry can only be prosecuted regarding the people of the Western world, not those of the Far East, because it is quite possible the Chinese had the advantage in this, as in many other things, for we know that this interesting people had already reached a very high state of civilization in the early history of the world, and they may have used glasses long before we heard of them. To-day they use glasses which come from Europe, and are very much like those we use. It was different at the commencement of the nineteenth century. In 1817 Ferrario figured a group of Chinese in which a man is shown wearing glasses connected by a bridge and held in

position by a string tied behind the ears. A similar picture is presented by Davis, in which a Chinaman is depicted wearing glasses held in position by weighted cords, which hang over the ears (Fig. 1). Other travellers at that time relate that glasses were widely worn in China, the large round discs of which were made from a brownish stone, which the Chinese call "tea" stone, because it resembles in colour an infusion of the leaves of this plant. Among the drawings of a Chinese artist a female native is depicted wearing large round mounted glasses secured with a string which goes behind the ears, and attached to the bridge is a piece of bent wire having a spread-out end which serves as a support, resting on the forehead (Fig. 2).

Two French writers have recently said that when Marco Poulou penetrated China in 1270 the inhabitants were wearing lunettes. Horner says that the only people of antiquity who may have used spectacles are the Chinese, and Pansier too thinks this possible, but neither presents any evidence in support of his statement. Inquiries on the part of others show that there is no trace of evidence that the Chinese used glasses in the Middle Ages. As far as can be ascertained, there is nothing in the writings of the ancient Jews showing they had a knowledge of spectacles. We can say with certainty that the Greeks and Romans of antiquity knew nothing of the subject of this discourse—that is, of lenses with a long focus—as no author speaks of it, neither have excavations revealed anything of the kind. The great European collections contain nothing that can be referred to this class, but various references are made to lenses made of glass or rock crystal, which have been found in different places, such as Nola, Mayence, Pompeii, Nineveh, and in England—all convex; but, in the sense of

spectacles, these lenses are out of the question, as they have too short a focus, and regarding their use we cannot get beyond conjecture; perhaps they served as magnifying and burning glasses.

Pliny and Seneca in places refer to the magnifying effect of a glass ball filled with water, like the well-known *Schusterkugel* of the Germans, by the aid of which the old cordwainers prosecuted their humble, though useful, calling. In this case the ancients attributed the magnifying effect of the ball to the water and not to the curved surface of the ball, and recognized the fact that with the help of such a device they were enabled to decipher small or indistinct writing. We cannot but be struck by the thought that the workers used some means of magnification when we reflect what small and fine work was done by the ancients in the art of precious stone cutting, some of the most beautiful work of antiquity still preserved; and it may be assumed that the extremely fine examples of Egyptian work in gold and precious stones, executed about 2000 B.C., could have been accomplished only with the aid of magnifying glasses. On this we can but hypothesize. There is ample evidence to show that biconvex lenses were used as burning glasses. Pliny tells us that glass balls filled with water were used by physicians for burning, and were to be bought from medicine dealers, and, perhaps, formed part of the armamentarium of the practitioner. What astonished them most in those days was that, in spite of the ball being full of cold water, it burnt.

The fact that Nero used an emerald when watching the gladiatorial contests would apparently end the contention that the ancients knew nothing of glasses. Tradition and

narrative of varying origin have spread this belief widely, because Nero used this emerald.

The ancients were well acquainted with short sight, but there is no suggestion of a concave glass. Neither is there any indication of the manner in which Nero's emerald was ground, nor of the manner in which it was used—that is, whether he looked through it or at it. It would be useful and of some importance to learn something of the size of this stone, which must have been considerable, and in so far was exceptional, for at that time, though emeralds were plentiful in Rome (obtained from the Ural Mountains), they were mostly small, so it is not unlikely that Nero used the emerald otherwise than as a lens to aid his vision; and we must find some other reason for its use which was probably this, that among the ancients the emerald had the reputation of being a means of strengthening the eye, for stonecutters were recommended to lay the stone they were cutting on an emerald or near it, and the fact that a green colour had an agreeable effect on the eye, which had been known from earliest times, appears to have been taken advantage of, and the Emperor's emerald may have been used as a real protective glass, which rendered his photophobia more easily tolerated. The green colour, on the other hand, may have been significant of the Emperor's political tendency, as the "party" openly manifested their partiality for the "greens" by wearing green dresses, strewing the floor with green sand, etc.

In the early Middle Ages we meet with the same difficulty in finding any trace of ground glasses with a long focus. We find even the same conditions prevailing at this time as obtained at the end of the early ages, which

need not excite our surprise, as the people of the early Christian era obtained their knowledge from the Greeks and Romans only. In old writings casual mention is made of magnifying glasses, but never of spectacles. Winfrid, the great Scot, called St. Boniface (A.D. 680–755), knew the effect of magnifying glasses, as also did the German poet Konrad, who died in 1287. The Arabian Alhazen, in the middle of the eleventh century, speaks of the magnification caused by a segment of a glass ball, and his commentator, Vitellio, was anxious to obtain such a glass to enable him to see small objects better. Roger Bacon, one of the most learned men of his day, was the first to make mention of glasses, in the year 1276. He remarks, in treating of the properties of glass lenses, of which he had a very valuable collection, “how useful they must be for those who are old and have weak sight.”

About the year 1300 glasses were well known in Germany, as is expressly signified by the lyric poets of that time, and, according to von Humboldt, they were then extensively used in Flanders. Pansier says that pictorial representations of biblical characters wearing glasses were made in the middle of the fourteenth century. The majority of direct references to the invention of glasses are met with in Italian authors. Of the sons of that country two are credited with it. They were Salvino d’Amato degli Armati and Alessandro della Spina. To the former the invention of glasses, in the year 1285, is attributed. He died in 1317. The Florentine antiquarian, Leopold del Migliore, discovered in a church in Florence an epitaph which ran as follows: “Here lies Salvino d’Armati of Florence, the inventor of spectacles. God forgive him his sins. Died in the year of our Lord

1317." Spina was a Dominican friar in the cloister of St. Catherine in Pisa. The archives of this monastery relate that he died in 1313, that he was a good man, of retiring disposition, who understood how to reproduce anything he saw, or of which he heard; he made glasses himself which were first made by some one who would not divulge the secret of their manufacture. With kind heart and willing hand he imparted what knowledge he had to his fellows. Giordano da Rivalto, a renowned preacher and divine of this same monastery, said after one of his sermons, preached on February 23rd, 1305: "It is barely twenty years since the art of making spectacles which enable us to see better was introduced, one of the most useful arts in the world. I have myself seen and spoken to the man who first made them." To whom he referred we do not know. This would give a date about 1280.

Dr. Franciscus Redi, physician and philosopher, writes to his friend Paul Falconeri, a Roman, in 1676, that he has an old manuscript dated 1299, which says in reference to correct writing and speaking, "I find myself so oppressed with years that without the glasses, known as spectacles, I have strength neither to read nor write. These have been lately invented for the conveniences of poor old people who are weak-sighted."

An account of the festivities in connexion with the marriage of the Duchess Jutta of Austria with Count Ludwig von Oettingen states that a guest, Pietro Buona-parte, ambassador to the Austrian Court, caused great excitement by appearing with glasses, called "beryls," across his nose, invented by the Florentine, Salvino degli Armati.

That glasses were invented at the end of the thirteenth century in Italy is abundantly shown by the great majority of contributors to the history of this subject, and either by Armati and Spina together or independently of each other. We read, however, that at the same time in Germany old people were using them, as they were also in Flanders. Other accounts agree in the statement that the same thing was going on in countries far removed from each other.

The references to Armati and Spina are so numerous that they have forced other traditions into the background, the chief of which declares that Roger Bacon was the discoverer. Caesamaker decides in favour of the learned Oxford monk, and there is much to be said for him when we take into consideration the general history, the things that were known, and the few who took interest in them. Heinrich Goethals, a close friend of Bacon, may have been entrusted with the secret of the invention and use of glasses and of Bacon's studies with magnifying glasses. He was commissioned to go to Rome to advocate a matter relating to his Order before Pope Martin IV. On his journey through Italy he heard the Pope was dead (A.D. 1285), and in order that the journey should not be made in vain he remained in Florence until a new Pope was chosen. Here he got to know Spina (the man who could reproduce anything of which he heard), who, from what Bacon's friend told him, it is said, made spectacles, so that Spina may have got his inspiration indirectly from Bacon. The sad fate which overtook the intelligent Oxford Franciscan explains why his name was not mentioned in this matter. Though in scientific knowledge by far excelling his contemporaries, his invention

was looked on as a sort of witchcraft, or as the work of the very devil himself. His name was of bad repute in Italy, as he frequently and emphatically reprehended the corrupt morals of the clergy. He was finally overcome by his enemies, for, after writing one of his letters to the Pope, they threw him into prison, where he languished until within a short time of his death.

The first medical man to mention glasses was Bernard Gordon, educated at Salerno, and professor in Montpellier. He said that they were not necessary, thanks to his remedies for eye complaints, which so excelled that they made those whose sight was failing able to read small print without the use of glasses. Guy de Chauliac, body physician to Popes Clement VI, Innocent VI, and Urban V, also lauded his own eye lotion, but added: "If this doesn't relieve you, then try eyeglasses."

No one at this time knew anything at all about the refraction of light, hence the senseless talk about the various remedies. The laws of optics, relating to glass lenses, have been known only since the time of Maurolycus (A.D. 1494-1575) and the immortal Kepler (A.D. 1571-1630). The physician who first ordered glasses in a professional capacity was one Montanus, a teacher in Padua. He ordered protecting glasses, reading glasses, and, some say, prisms. Physicians at this time evinced great hostility to the wearing of glasses, and owing to the way in which they dissuaded the people from their use, it was not to be expected that it would spread very rapidly. The chief among these was Georg Bartisch, of Königsbrück, near Dresden, the author of the first German book on ophthalmology. Even into the nineteenth century they considered it beneath their dignity to order proper glasses

for anybody, and left it to dealers, who, even in our time, surround the testing for glasses with a mysterious air. It was only in the middle of the nineteenth century that fixed printed testing types were obtainable by ophthalmic surgeons. Until the laws of optics were discovered which was long after spectacles came into use, these were considered things of mystery; people attributed a secret power to lenses by the aid of which they could read and write. Franz de Paula (died A.D. 1507) declared that his lost vision was quite restored by the use of glasses. Theophrastus Paracelsus, the wonderful chemist and doctor, who spoiled an otherwise worthy reputation by "crying in the markets," speaks of an *ars berillistica*, and considered spectacles a consecrated crystal in which one could see the events of the future. In the year 1551 Record related that Roger Bacon had ground a glass in which he could verily see the devil at play.

It is not difficult to explain why our knowledge of the advent of spectacles is so spare and deficient. About the time at which the events of which we have spoken were taking place, the methods of communicating them to successors were very few and primitive, the only means at disposal being writing on either parchment or stone. The latter has at least preserved the name of the inventor of spectacles.

There were comparatively few of the costly manuscripts at the time when the art of writing and illuminating them was first practised, and only a few have resisted the destruction caused by the unrelenting hand of time, and thus have been preserved. In a sketch of the Council of Constance by Richtenthal in the library of Prague University (Fig. 3), the Chancellor is represented with

glasses clipped on his nose (A.D. 1417), while in part of the same manuscript preserved in the library of the Royal Academy of Arts in St. Petersburg none is seen wearing glasses, though it abounds in figures. Paintings may be considered important sources of information. We do not possess many pictures executed in the early days of the spectacle era, and the artist, whatever his imagination might be, would never have sullied his reputation by introducing subjects wearing glasses. In some degree this was different in the fifteenth century, when great artists produced great works rich in figures, when the reproduction of drawings by copper engravings or woodcuts began, and when the art of printing in unparalleled triumph transformed the whole life of mankind.

To the caricaturist our subject presents a rich field, and many express by their productions the use and form of glasses. These are also useful in giving us the period of the production of the picture — not that of the subject. In the same way, according to the choice of the painter who thought fit to dress his biblical characters in costumes of the Middle Ages, so also we find in such pictures people wearing glasses. Examples of this are seen in the “*Adulteress*” by Kranach, and in “*The Widow’s Mite*” by Titian in the Louvre; an old Jew is seen in each wearing glasses. Although the number of such pictures is considerable, yet it is relatively small considering the enormous number of pictures in which we seek in vain for any subject wearing glasses. This is particularly the case with pictures in which numbers of individuals of different standing are represented. Not only in miniatures of divines, philosophers, and others, but in wall and panel paintings, especially taking at random such paintings as those of

Paul Veronese in Venice, Raphael's Stanzas in Rome, "Triumph of Death" in Pisa, wall paintings of Pinturricchio in the library of Siena, and pictures of the Netherlands of the seventeenth and eighteenth centuries, and in many others representing hundreds of pictures and thousands of people, yet not one wearing glasses, while other things, such as tobacco pipes, are in strong evidence. The same may be said of bodies of divines, physicians and learned men in general. In single representations of men of various callings we see their various insignia, but no trace of spectacles. In representations of the audiences of theatres not a single individual is seen wearing glasses. A comparison of these with similar representations of the nineteenth century shows a different condition of things, for we regularly see people represented wearing glasses. The medical man is nearly always so represented in order to distinguish him from others. There is also another great difference between the periods. In former centuries few people used glasses at all, still fewer wore them; this difference is all the more marked when we consider that the eyes of mankind, with the exception of some increase in myopia, have not changed. There must have been some cause or causes at work which prevented the general adoption of glasses as an aid to vision. As a matter of fact, such causes did obtain; not only did doctors themselves refrain from wearing them, but they distinctly dissuaded the people from doing so. From lack of means of quick locomotion in the Middle Ages and early modern times a long period was required for glasses to become known to a wide circle, and, as I have said, they were looked on as a kind of magic toy until such time as the laws govern-

ing the action of lenses on light were known. Still other causes may be adduced. It must be remembered that life in the old days seldom rendered it necessary to use glasses, as few people followed any calling which demanded acute vision. Watchmakers, workers in gold, engravers, doctors, men of letters, and teachers were not so frequently met with as nowadays. Even members of such bodies were but seldom depicted wearing glasses, whereas with the physician the urine glass never failed. Those who had not good vision avoided such occupations as required it. The world was not quite so well filled as it is to-day. The choice of occupation and the obtaining of a livelihood were not so difficult, and we know that among the monks those only were entrusted with the execution of manuscripts to whom writing and painting presented no difficulties. History relates that monks suffered from cramp in the arms and hands from prolonged writing, but there is no mention of difficulty in seeing; Witkerb, Abbot of Tours (tenth century), renowned for the wonderful manuscripts he produced, wrote his last one in his 90th year. Neither did the invention of printing, which brought the reading of books to a wide circle, tend to the increased use of glasses, for then the books were so large that they were carried on a stand, and the thick letters could be deciphered without difficulty. The number of those who wore glasses relatively to those who actually required them was still lessened by want of training and the inferior social position of the women of that period. Women and girls who at that time were able to read and write with facility formed such remarkable exceptions that those who possessed that faculty were considered to be highly accomplished. Pictures

showing women wearing glasses are extremely rare, and not one has been seen showing children wearing them, and all men shown wearing glasses have the mark of advanced age.

We need not wonder that in early times men were strongly opposed to this custom, as at first glasses were ill-shaped and most disagreeably striking in appearance, and, more than this, they directed the attention to a physical disability.

Patients wearing glasses were made fun of, and not altogether in a very tender manner. On the title-page of a satire on a tailor, published in the sixteenth century, two goats are represented standing erect on hind legs, the one on the left wearing glasses, and at the same time ejecting the contents of the lower part of his digestive apparatus. In the year 1494 a caricature of a bibliomania was published by Sebastian Brandt, representing that individual wearing a very ungainly pair of nose nippers (Fig. 4). In a series of caricatures published in 1715 a dwarf is depicted in clown's dress executing a somersault, and on the buttocks, which part is directed to the spectators, is sketched a pair of glasses (Fig. 5). Many other examples of the caricaturist's art executed at this period are extant, and are evidently intended to show to what ridicule people were subject who availed themselves of this valuable aid to vision. The shadow of this ridicule accompanied the wearing of glasses for a long time, even unto the nineteenth century. Thus does valuable knowledge travel slowly.

Their prohibitive costliness rendered the wide adoption of spectacles impossible. At the end of the sixteenth century the price per pair, expressed in terms of present-

day value, was from £10 to £20. From this circumstance glasses which frequently had costly ornamental fittings were seldom seen, and then in the possession of wealthy people only. They were enumerated among the possessions of the owner, and in testamentary dispositions were particularly mentioned—for example, in 1372, in the will of King John of France and in that of Charles V of France, and also in a list of belongings of St. Antonine, Archbishop of Florence (died 1446). They could not always be obtained, even for large amounts of money. The Elector of Saxony in 1570, then in his 48th year, just about the time when his presbyopia and latent hypermetropia, if he had any, were rapidly becoming manifest, sent his servant to Augsburg to get him a pair, which, however, he could not there obtain; he was obliged to go to Venice, where he accomplished his mission. Lenses, too, were made in very few places, and the art of preparing them was very jealously guarded as a valuable secret. This secret was held until the sixteenth century, when it was lost, as was that of the manufacture of artificial eyes through treachery, and the secret quickly spread to other lands. Venice for a long time was the only place where good glasses were made. The factories were placed at some distance from the town in order to avoid the danger of fire; even here, though the home of the manufacture of this valuable article, it found no favour, probably because the highly developed sense of the beautiful in the Venetians resented such a menace to their pleasing exterior. Treatises on arts and manufactures of the eighteenth century give a prominent place to the making of glasses for spectacles, and, as far as we are able to gather, Germany was the chief country which produced them. The places selected were

those that had made themselves famous for industry—namely, Nuremberg, Regensburg, and Augsburg. In France spectacle-makers were included in the Reflector and Toy-makers' Guild, and were mentioned in a new statute granted by Henry III in 1581. This order, or company as we call it to-day, possessed its own heraldic emblem, whereon is figured a mirror between two pairs of eyeglasses (Fig. 6). For the production of lenses fine Venetian glass as well as flint and crown glass was used. When we read that the raw material was provided by the beryl, we must not forget that under this name to-day many kinds of precious stones are included, from the dull or transparent and variably coloured crystals to the more costly variety, the aquamarine, and the mostly prized of all, the emerald. In the Middle Ages every transparent stone, even glass, was named "beryl," and there is no reason for doubting that lenses were ground from beryl—not the finer varieties, but from those of a less attractive virtue. Such crystals have been found in England and France, having a length of 1 to 2 metres, weighing 1,500 kilos, and chiefly grey or brown in colour. This recalls the topaz used by the Chinese, which has great variety in colour and markings. About the middle of the nineteenth century the most preferred and at the same time—as is usually the case—the most expensive glasses were made from Brazilian rock crystal, the "pebble" of to-day, which is characterized by its peculiar clearness and hardness. In 1591 a maker prepared glasses from amber saturated in linseed oil, which made the amber transparent and colourless. These were probably used as protectors, as were discs of mica used later. The lenses were not always round; some were oval, others square

or even octagonal. At first—and probably with Armati—the lenses had figures scratched on them, indicating the age of the individual for whom they were considered most suitable—a quite arbitrary notation, which in the most favourable case rested on very small experience; this method was given up, but on what ground is unknown. The designation of lenses according to their focal length was generally adopted about the middle of the nineteenth century. In the second half of the eighteenth century they were graduated according to their focal length in inches, and even then each maker had his own method of differentiation. A long time elapsed before glasses were made comfortable for wear. Perhaps a reference to pictorial representation will do more than I can say to give you some idea of the evolution of the spectacle frame (Figs. 7—13). The oldest form is the reading glass for old people (it still survives), round, and mounted in metal rim with long handle; this continued in general use until the nineteenth century. The lenses were large and thick and the rim not unusually made from one of the precious metals and highly ornamented; many of these had protecting cases, which were used as handles; these single glasses were used by every nation in Europe. During the time of the first French Empire the use of these glasses was associated with a certain amount of foppishness and coxcombry, and it was the fashion with men, as well as with women, to swing in an elegant manner a large glass with a handle, and to put it before the eye (chiefly the left) from time to time, as though observing persons and things in earnest, but it was impudence more than anything else (Fig. 14); such glasses were very often simply plain glass,

the possessor being neither myopic nor hypermetropic. The history of the monocle I have not been able to trace. From this single glass, frames with two lenses evolved at the end of the fifteenth century. Each glass had a support, and these were fastened together at the end, or were bound together with an overlapping joint, and sometimes furnished with a protecting case (Fig. 10). This form went out of fashion later, and was reintroduced at the end of the first French Revolution, partly as a useful instrument and partly by the fops. At the commencement of the fifteenth century we find the glasses connected with each other by a very thick bar or bridge, the forerunner of the later adopted pince-nez, but still not so constructed as to sit or grip the nose firmly (Figs. 10—11).

Savonarola in one of his sermons advised those who wore glasses to attach them to the peak of the cap, which latter should be well pushed down on the head, a method that survived a long time, but it was never popular. Glasses at this time were mounted in heavy frames of wood or leather, and maintained in position by means of a cord tied behind the ears. Later, mountings were of gold, silver, steel, fishbones, and variously coloured horn. These were provided with side pieces for holding them in position, mostly of metal, but so thick and clumsy that the whole thing looked like the production of a village blacksmith; this obtained until the end of the eighteenth century, when the much lighter constructed sides made their appearance. Such as we see nowadays were not made until the Thirties of last century. The cumbrous nose-riders, then so-called, soon made way for those provided with springs, and the clumsiness was relieved somewhat by various perforations of the coloured horn

mountings. The spring arrangement preceded by some time the adoption of a joint between the two glasses (shown in one of the pictures) (Figs. 9a, No. 1), which was adapted to a better fit by allowing the glasses to grip the nose. The springs were of different form and size. To make them at all certain of retaining their position on the nose was reserved for later times, for well into the eighteenth century all eyeglasses fitted very badly and so uncertainly that they must either be kept in position by hand or pushed forward into the fold between the cheek and nose; this continued until the nineteenth century. The precursor of the metal spring was one made from horn or fishbone, shown in one of the photographs (Fig. 9a, No. 3). The use of the string or cord commenced with the nineteenth century. At the end of the fifteenth century various ornamentations were added to or cut in the frames among the better class of people, consistent with the greater care exercised in dress characteristic of this period—hearts, crowns, trefoils, acorns, and human faces. These were exceptions, as already said, the cumbrous form prevailing well into comparatively recent times. The weight of the glasses was chiefly accounted for by the size and thickness of the lenses, as they were mostly of short focus. A picture by Watteau, painted a little time before his death (A.D. 1720), gives the first representation of the long-handled lorgnette as we see it to-day.

Glasses were sold chiefly by pedlars, mostly Jews, who occupied themselves also with grinding the lenses. These hawkers must have aroused some interest and curiosity, as they became the subject of numerous pictures, of which you see one or two copies. These dealers carried their wares from place to place so long as there were no resident

eye doctors, the only representative of the ophthalmic surgeon being the cataract coucher, such as is seen to-day in the Balkans and in India. These wanderers made glasses one of their most fertile sources of income; they gave themselves pompous sounding names, pretending to be real eye doctors, selling expensive glasses, not only for near and distant vision, but for the cure of diseases of the eye; and many of these gentry recommended glasses for reading to those who had not learnt that art. They were also sold in respectable shops in Germany, and at the beginning of the seventeenth century legal protection was extended to the manufacturers (Figs. 15, 16, 17).

The makers of glasses were mostly skilled in other fine work, such as carving in ivory, bone, and wood. The shops of respectable dealers were made known by signs such as we see to-day, but of a more primitive character, as shown in the pictures (Fig. 18).

The lenses referred to in the foregoing remarks have been of the convex kind. The history of the development and use of the concave lens is very different from that of the convex variety; it came on the scene much later. There is no mention whatever of concave glasses by the ancients, though short-sightedness was well known, not as an error of refraction, but as a weakness of the eye. Theophrastus relates that the tyrant Dionysius (460 B.C.) was short-sighted, and his courtiers flattered him by feigning a similar affliction. Aristotle discusses the cause of blinking and the small writing of the myope. From some remarks of Pliny we may conclude that short sight was not uncommon even in his day. The well-known Arabian physician, Avicenna (A.D. 980-1037), the learned Dominican, Albertus Magnus (A.D. 1193-1280), and other

authors from the twelfth to the seventeenth centuries relate that not only was short-sightedness well known, but that in Italy it was very common, a circumstance most likely having connexion with the great number of students and the high rate of civilization and advanced education in that country. This myopia engaged the attention of many learned men. Cardanus (A.D. 1501–1576), mathematician, philosopher, and physician in Pavia, made the mind and disposition of the myopic the subject of dissertation without having the slightest idea of the nature and cause of the condition. Roger Bacon was the first to mention concave glasses (A.D. 1276), but it was not until the end of the sixteenth century that we find the first clear description, and that was given by John, Archbishop of Canterbury, in the year 1593. Porta also described the effect of concave glasses on short sight. The optical nature of myopia, as said before, was first discussed by Kepler, and some time after Zahn, in the year 1685, first described the grinding of concave lenses. Compared with convex lenses, a much longer time elapsed before they came into general use, as there were many more obstacles in the way of progress for this than for the reading glass. The life of that day did not lend itself to the desire or even necessity of improved vision for distance. The houses were compressed within small space, streets were narrow and dark, and the people were little inclined for the open; the short-sighted instinctively avoided occupations and pleasures demanding good vision for distant objects, such as the military and hunting, though Leo X was an exception to this, for he hunted with a concave glass, and in spite of his myopia is said to have seen better than his companions; a picture by Raphael, painted

A.D. 1517, corroborates what history says, as he is represented sitting between his two cardinals holding a single glass, which is evidently concave. He has the typical appearance of a myope (Fig. 19).

So that we can assume with a fair degree of certainty that concave glasses came into use about the middle of the sixteenth century. Stilling found in a book on duelling (A.D. 1551) rules laid down for the short-sighted, so that they should not stand at a disadvantage when engaging with one whose vision was normal. We also find that helmets for myopes were used in war. Specially made appliances were attached to the visor with small slits through which the short-sighted wearer could look. It is a well known fact that myopes can see better through small holes, as the peripheral rays of the cone of light are cut off. In Dante's time glass protectors were used in the visor to keep the dust from the eyes of the warrior. Had concave glasses been known at this time they would in all likelihood have been put into the helmets of the short-sighted, but there is no evidence of this. By the eighteenth century concave glasses were widely used, and it was then understood that the lorgnette had reference to glasses for distant vision only.

It was remarked by numerous observers that many were affected with weak eyes who were neither long nor short sighted, and who were not at all benefited by concave or convex glasses. It was reserved for Thomas Young to clear up this question, which he explained as being due to an abnormal curvature of the cornea, to which the name of astigmatism was given. It was while at Göttingen that Young made his first communication on this subject, which was soon followed by others from different

observers. It was, however, a long time before anything was done in the way of relieving the symptoms produced by this condition, and, as you well know, cylindrical lenses, either concave or convex, according to the error of refraction, were discovered to be the only help. Cassas the painter recognized his own astigmatism in 1818, but not until 1844 did Suscipi, the Roman optician, succeed in fitting him with suitable glasses. Goodrich, a divine, was fitted by the optician McAlister in Philadelphia in 1828 with a concave cylinder. Airey of Cambridge described the astigmatism of his own eyes, which was corrected by Fuller of Ipswich. Goode also discovered the same condition in himself, and Chamblant in Paris gave him the correcting glass. To-day it is the daily duty of every ophthalmic surgeon, and should form part of his work, to estimate and give the proper glass for astigmatism, which can be done easily, thanks to the appliances available. Periscopic lenses are of somewhat ancient date. They were recommended as the objective of the telescope in 1660. At the end of the eighteenth century Smith advised their use along with spectacle lenses, but it was Wollaston, in 1804, who introduced them into practice under the name by which they are now known. Made first by the English optician Dollond, they were introduced into France in 1813. Achromatic lenses were first made for spectacles by Charles Chevalier in the middle of last century, and, according to Desmarres, it was he who was also the first to recommend the use of prisms, about the year 1844, "as a great help in the treatment of squint." Hyperbolic glasses made their appearance in 1879 at the Ophthalmological Congress in Heidelberg. Rühlman of Dorpat recommended them for conical cornea

and irregular astigmatism. The lenses were 4 cm. in diameter and the cone had a depth of $\frac{1}{2}$ to 2 mm.

Protective glasses came into use at the end of the seventeenth century. Ambroise Paré recommended those who had been operated on for cataract to wear green glasses. They were unpopular, as certain peculiarities were supposed to attach to individuals who wore them, such as moroseness, unsociability, and depression of spirits, a connexion not altogether avoidable at the present day.

Prejudice against the use of glasses still exists. However daintily made, many people will not wear them unless in practical solitude, and still more will not be seen outside wearing them, though, happily, these are in the minority. Such prejudices die hard, and I think we have practically escaped from the thralldom that held us, and the public are now convinced that the wearing of proper glasses can be counted as nothing but a benefit to those for whom they are intended.

I thought of devoting a few minutes to the consideration of the value of this discovery to the public. It can be stated definitely that it was given to the world quite independently of the medical profession; in fact, had the advice of medical men been taken, the time of general adoption of glasses as an aid to vision might have been considerably postponed; but this can be said, that it was left for the medical profession to put the estimation and treatment of errors of refraction on a strictly scientific basis. Donders made a name which will abide so long as ophthalmology is practised, and Helmholtz, accredited also with the discovery of the ophthalmoscope, gave physiological optics such a strictly mathematically scien-

tific foundation that few of us can follow him in his abstractions.

The ampler my experience becomes, the more I am convinced that the only person who should correct the vision of the ametropic is a well-qualified, experienced ophthalmic surgeon. As well as the various anomalies of refraction, he must be able to detect and treat the several disturbances of the ocular muscles, one of the most difficult branches of ophthalmology. The varieties of heterophoria are numerous and their treatment often exceedingly difficult, especially hyperphoria, and it is in such cases that prisms act as a veritable charm, and render a life comfortable which before relief was obtained was nothing but continual misery. Beside the knowledge necessary to correct a simple error of refraction, it is very important to be able to distinguish between the various forms of squint, concomitant and paralytic, congenital word-blindness, congenital cataract, and many other conditions; and last, but greatest of all, to be able to interpret correctly the appearances of the fundus oculi as revealed by the ophthalmoscope.

My opinion is that any one attempting the prescribing of glasses who is ignorant of these points, and is unable to use the ophthalmoscope, courts disaster, is doing a great injustice to himself, and a still greater injustice and perhaps permanent injury to his patient.

It is to the everlasting credit and honour of our profession that we are the last to endeavour to put a value on our own art, charitably practised; I mean, to calculate what the value of it may be to the recipient. I rather think we err too much in this direction, and that on occasion the public should be reminded to what extent

they really are indebted to us, especially those who get hospital treatment.

During the last seventeen years, that is the time I have been connected with the Royal Eye and Ear Hospital at Bradford, something like 35,000 pairs of spectacles have been prescribed by the staff. What real value in cash has that been to those benefited? It is always a difficult thing to appraise the value of medical work; at most we can only approximate. Taking the average duration of life of these 35,000 patients at ten years, which is extremely low, and much more likely to be far below the mark than otherwise, this would give 350,000 years distributed among the 35,000 people. What would be the average gain per head resultant on wearing glasses? Would £20 per annum be too high? I think not, considering that a large number over 50 could not earn a living at all without glasses; but take it at half that, and you will get a result which will surprise all those who have not considered this question before—namely, that within the last seventeen years the wage-earning capacity of this neighbourhood has been increased by no less a sum than £3,500,000, and this advantage has been conferred on the community by the staff of the Royal Eye and Ear Hospital by the prescribing of glasses only.

Sir Jonathan Hutchinson, in speaking publicly on this subject a few years ago*—that is, the value of ophthalmic science—claimed that the saving to the community by the operations done for senile cataract alone at the Royal London Ophthalmic Hospital was no less than £104,000 per annum. This amount would be reduced to *nil*—

* Special report of the Mansion House meeting in support of the Royal London Ophthalmic Hospital, February 1st, 1897.

nothing—if the patients were not able to get suitable glasses.

These figures are, if anything, too low an estimate, and when the increased comfort and pleasure the wearers enjoy is added to other advantages it may be justly allowed that few greater benefits have been conferred on mankind than the invention of spectacles.

(The pictures referred to in the text—a series of artistic prints from various sources, illustrating points referred to by the speaker—were passed round the audience during the address.)

AUTHORS CONSULTED.

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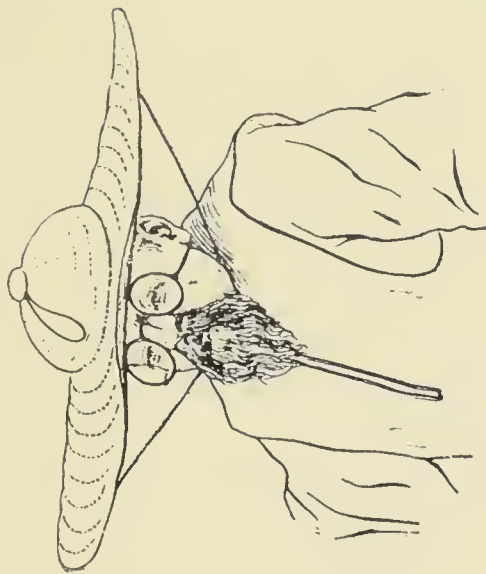
Baas: *Die geschichtliche Entwicklung des ärztlichen Standes*, 1896.

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Afer Ferrario, 1817.

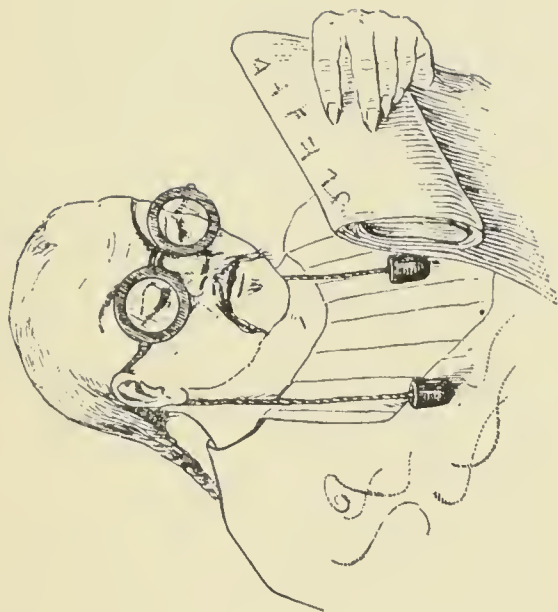


Fig. I.

From Davis, "The Chinese," 1836.

Examples of the method of wearing glasses (both Chinese).



Fig. 2.
Ancient form of glasses worn by the Chinese.



Fig. 3.

Showing kind of glasses worn in Germany, 1417.

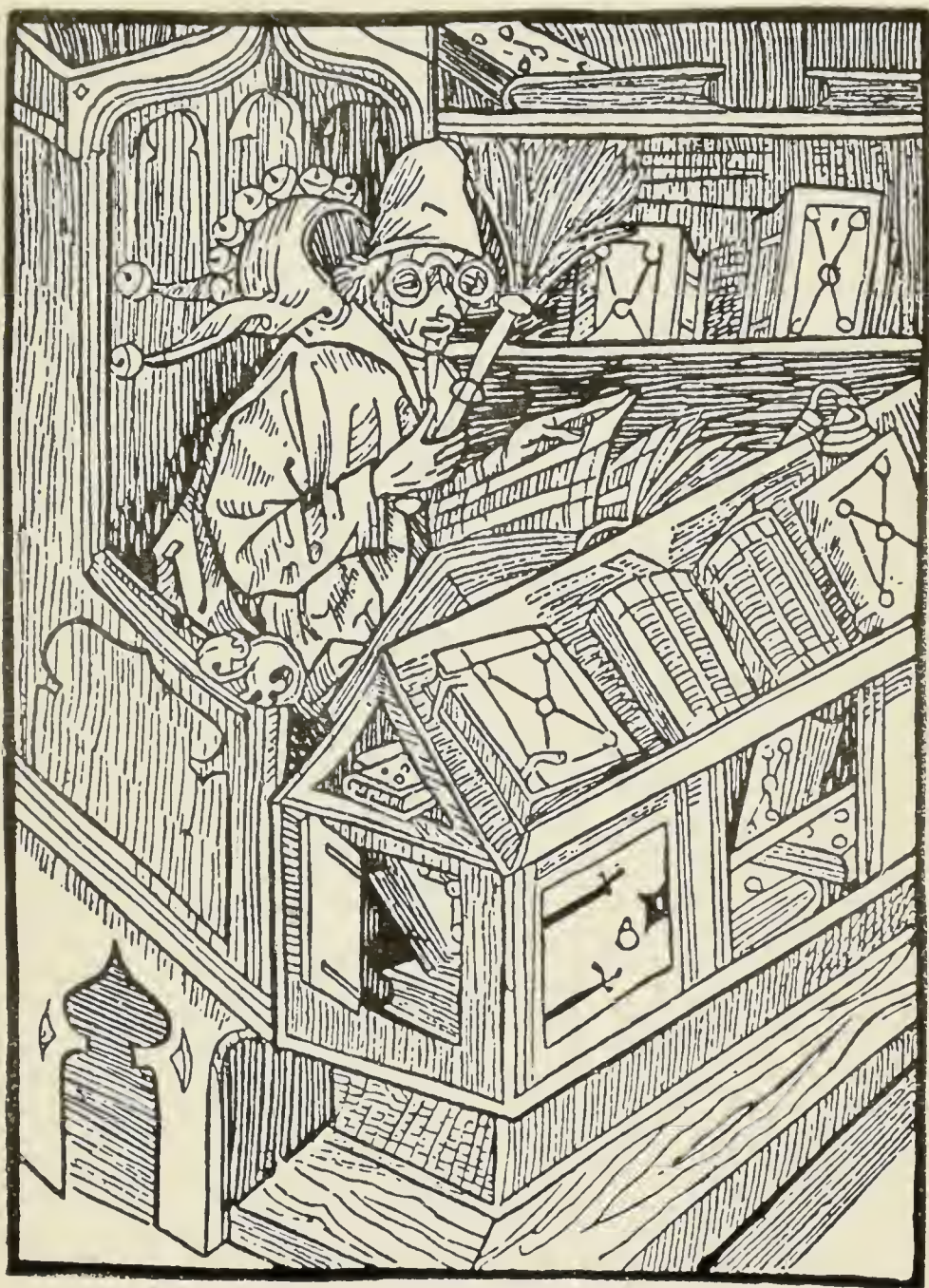


Fig. 4.
The Bibliomaniac (Satire). After Sebastian Brant, 1494.

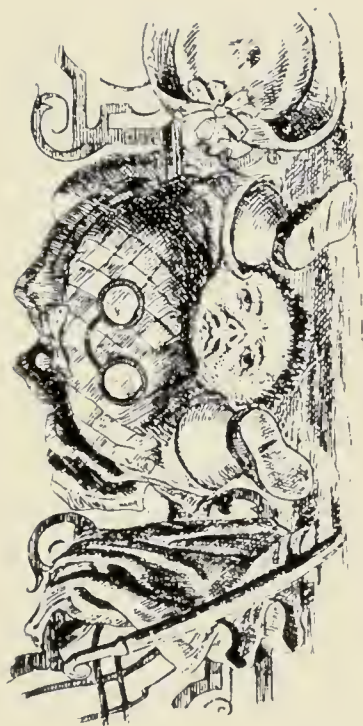


Fig. 5.

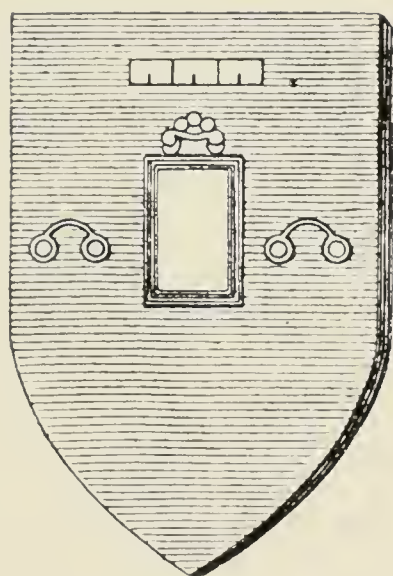


Fig. 6.

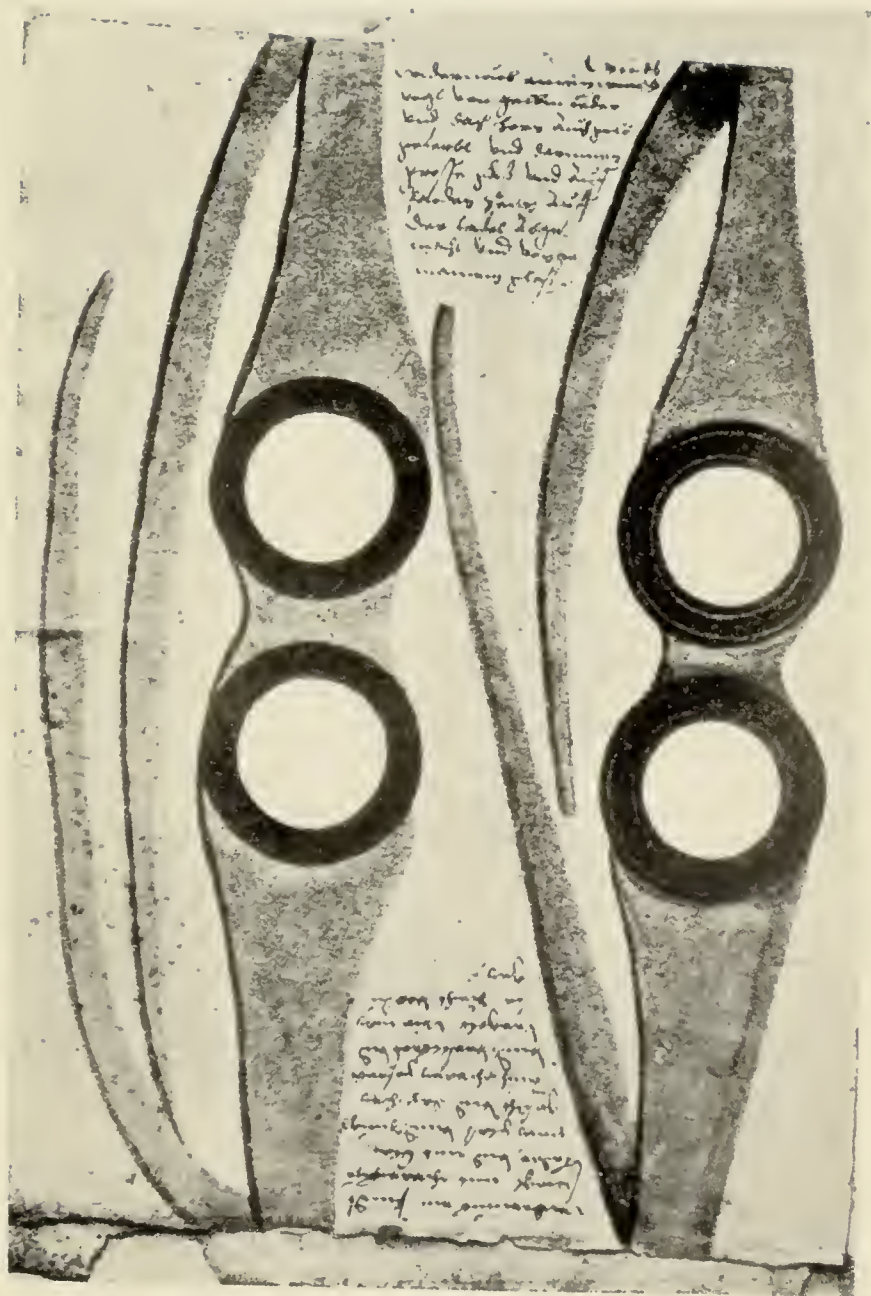


Fig. 7.

Glasses of the 16th century, mounted in horn, leather sides.

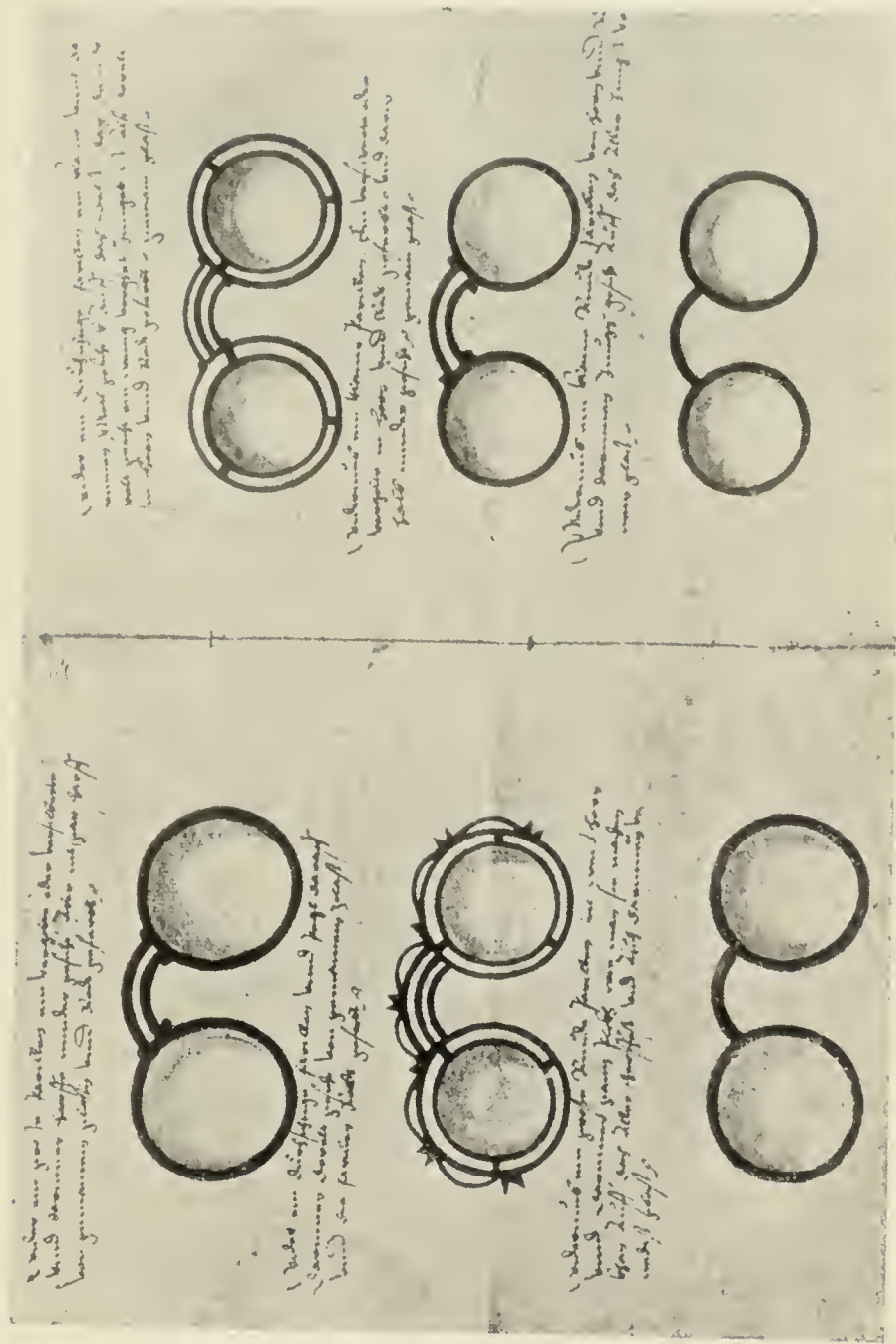


Fig. 8.

16th century glasses in various mountings and for different ages.

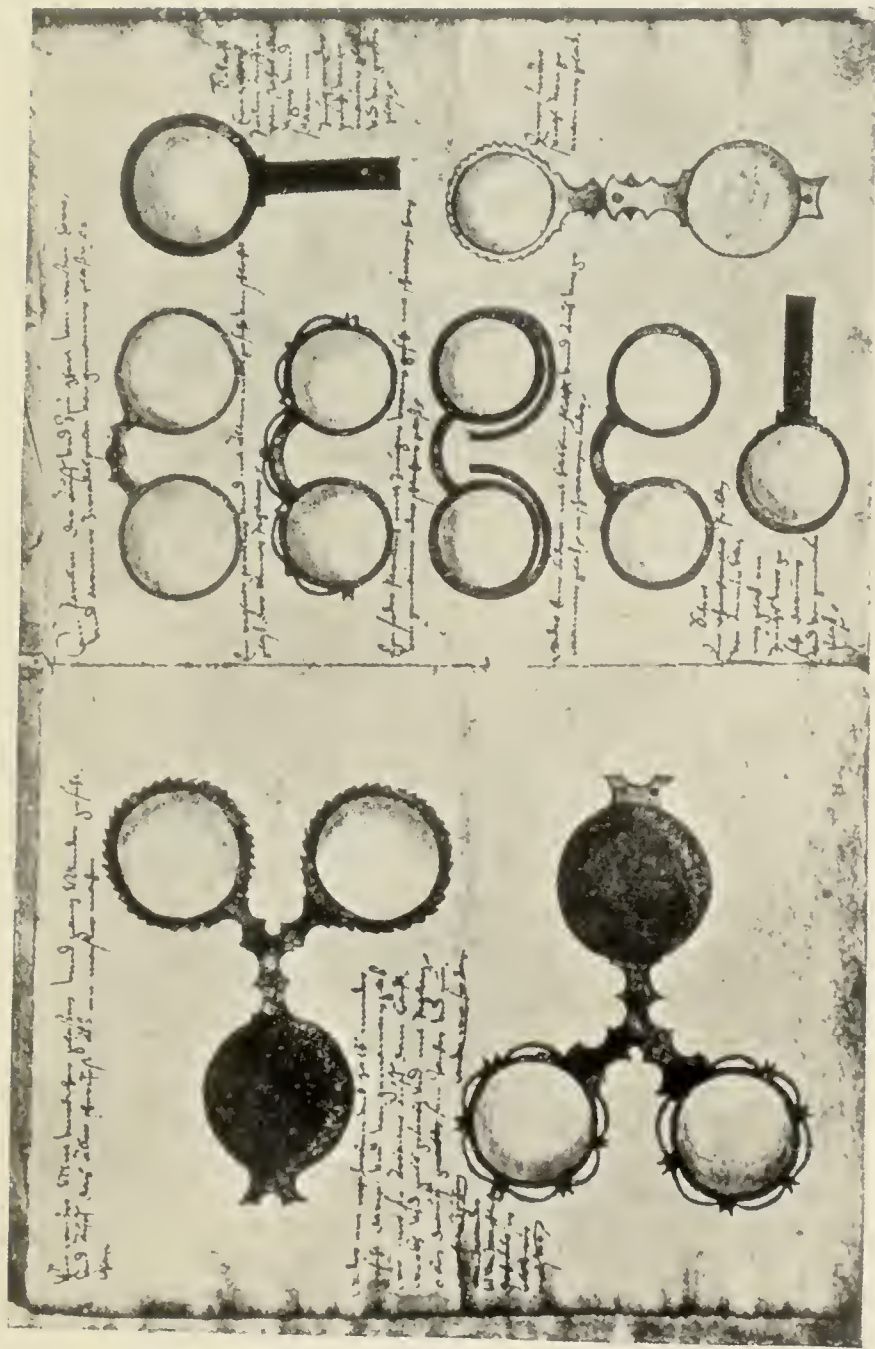


Fig. 9.

Masterpieces of the makers' art.
16th century.

Fig. 9a.

No. 3 shows the first indication
of a spring—fish bone.



The earliest kind of double glasses; they are carried on a single stem.



Fig. 10.

The evolution of the spring bridge.



Fig. II.

The Spectacle Dealer. After an engraving by Dupuis (1696-1770).
Painted by Franz Eisen.



Fig. 12

Quack, 17th century. Big Glasses.



Fig. 14.
An insolent way of looking at a rival. French 18th century.

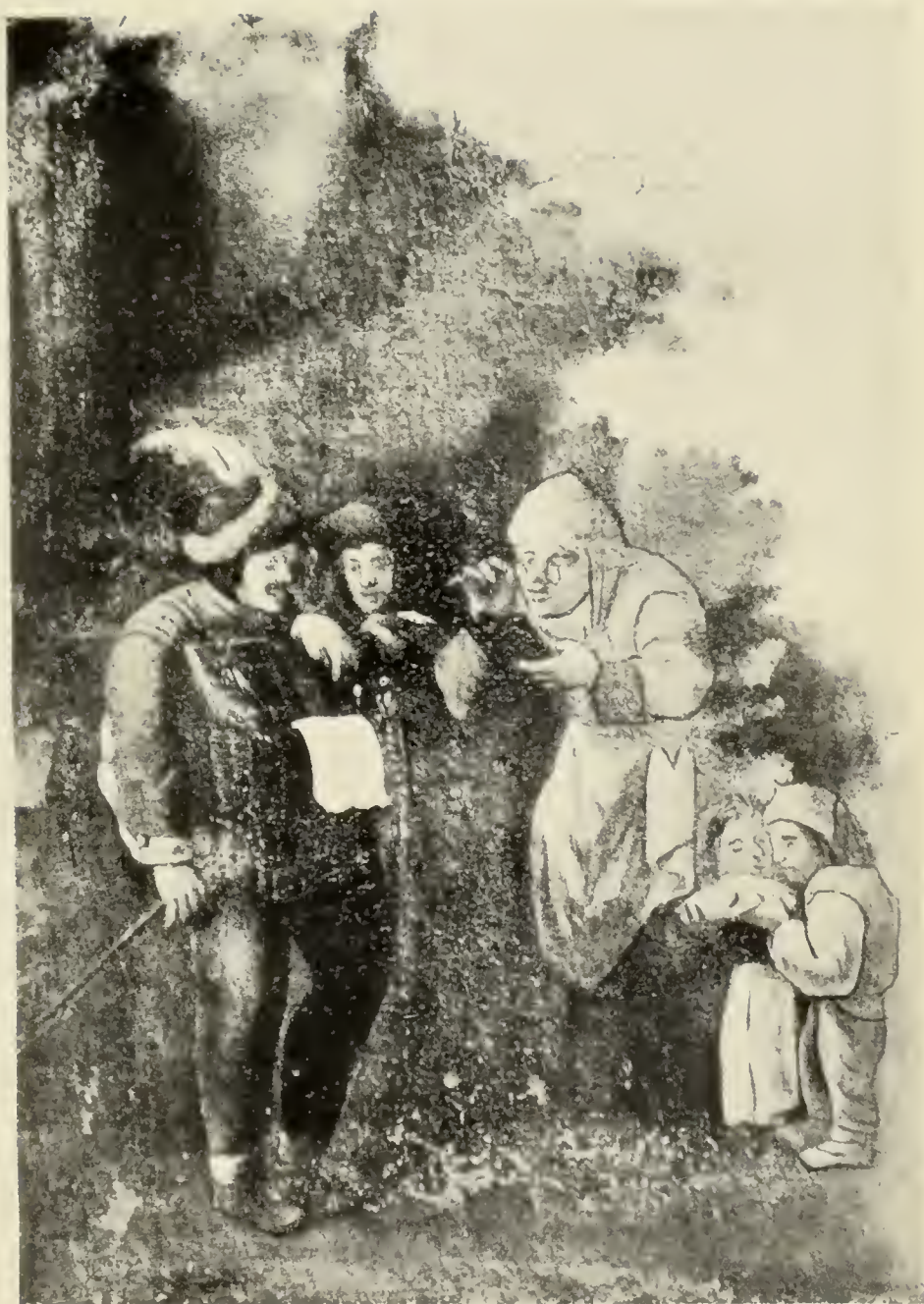


Fig. 15.

Jewish Pedlar; sells glasses. After Droochsloot, 16th century (Dutch).



Fig. 16.

Itinerant glass vendor. After an engraving by Dietrich, 1741.



Fig. 17.

A toy and spectacle seller (Hawker) in 1740.

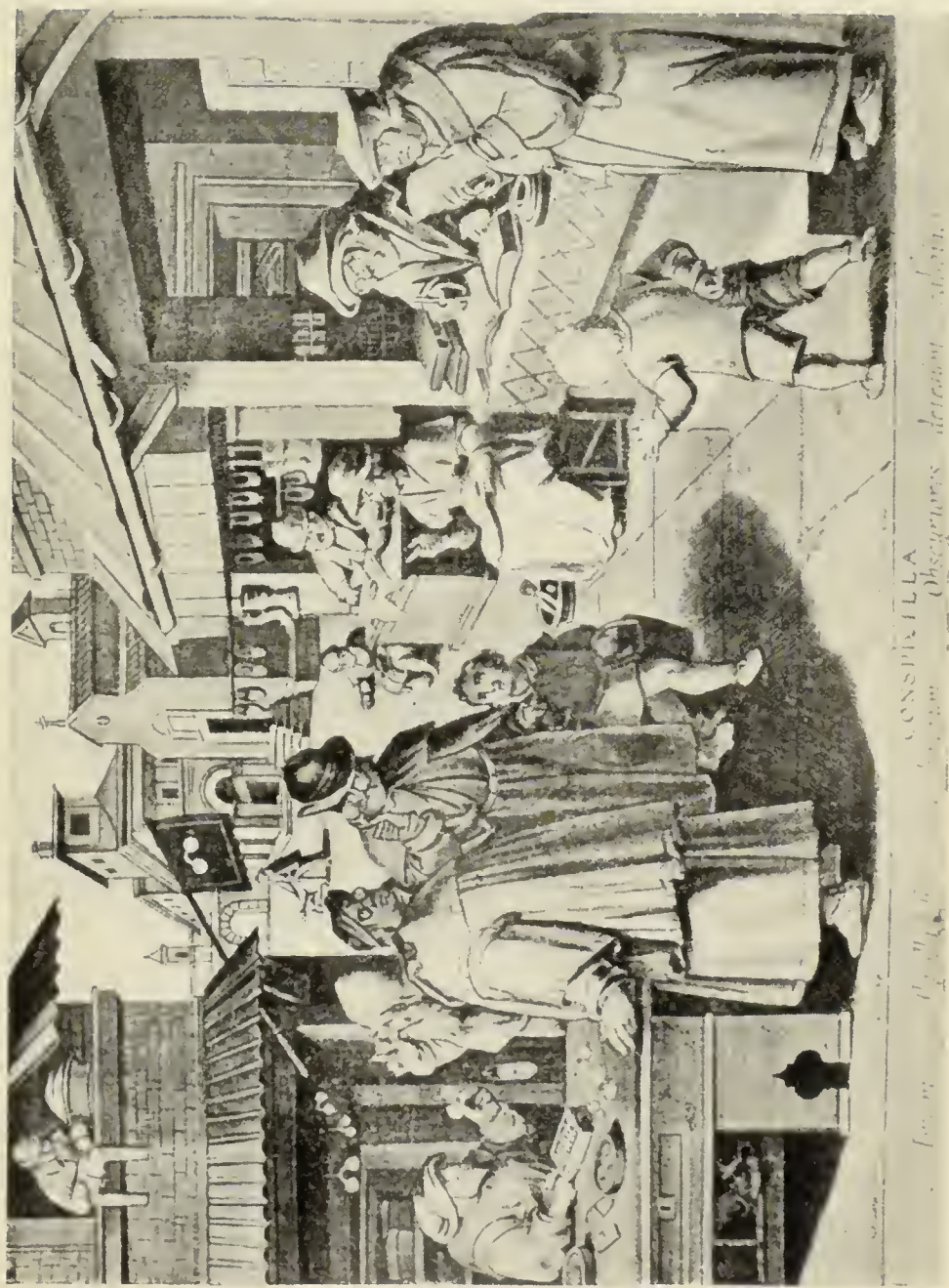


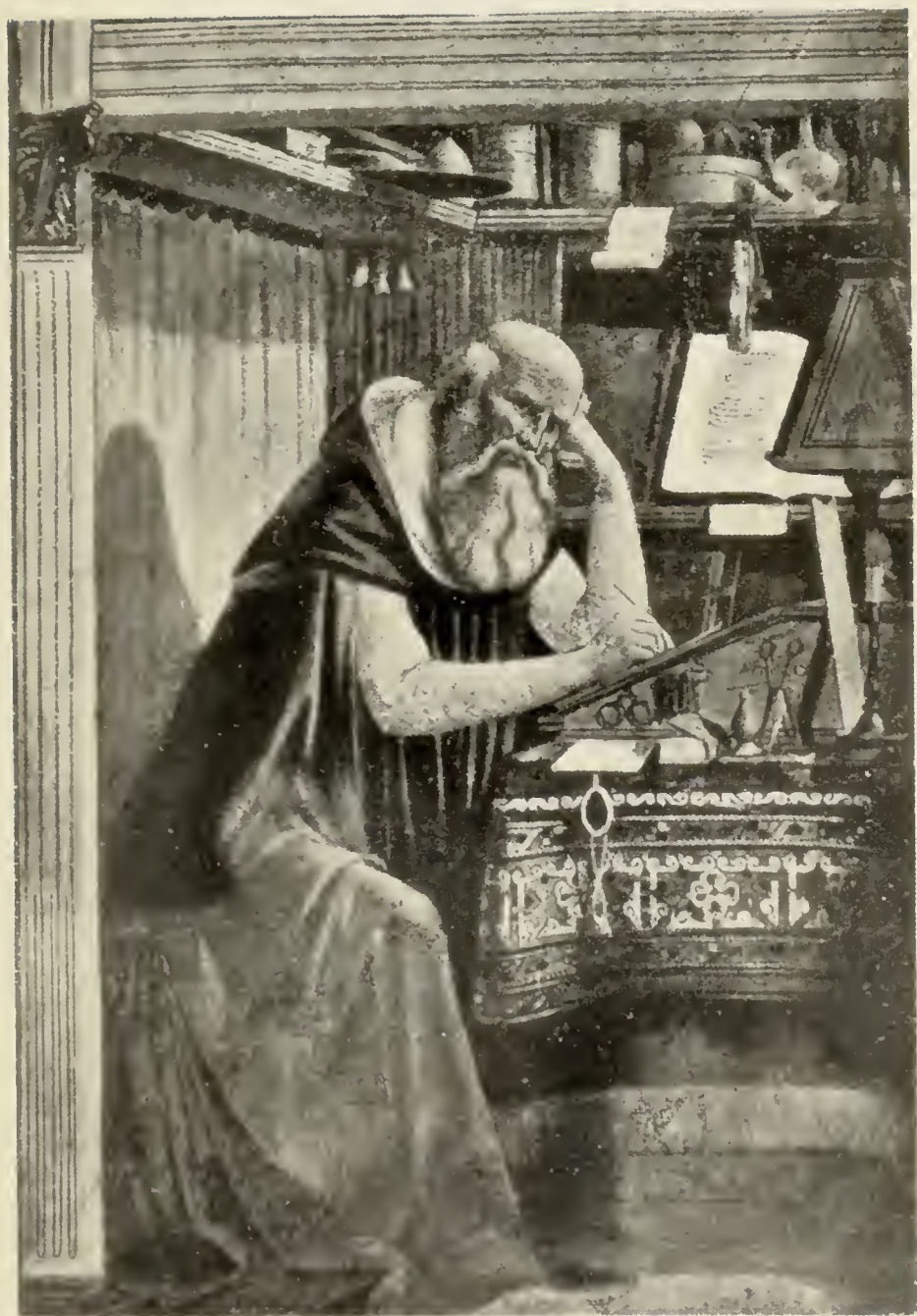
Fig. 18.

A Spectacle Merchant of the 16th century. Note the shop sign.



Fig 19.

After Raphael. Pope Leo X. with concave lens in right hand.



St. Hieronymus. Wall painting by Ghirlandajo, 15th century, in the Church Ognissanti in Florence (Glasses on side of desk).



Madonna, St. George and St. Donatus. After Jan van Eyck, 15th century.



The only stone statue showing glasses. In a museum in Vienna. 15th century.



A medical consultation, 1524.

From a painting on glass (Swiss).





After an engraving by Rembrandt, 17th century. Large glasses.



Various coins on which eyeglasses are shown. Early 17th century.

